
Trends in Food and Nutrient Intakes by Adolescents in the United States

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Evaluations of dietary trends can show whether food habits are changing in recommended directions. Trends in intakes among adolescents age 12 to 19 years were examined by using data from the Continuing Survey of Food Intakes by Individuals (CSFII) 1994-96, the CSFII 1989-91, and the Nationwide Food Consumption Survey 1977-78. Increases were seen in intakes of soft drinks, grain mixtures, crackers/popcorn/pretzels/corn chips, fried potatoes, noncitrus juices/nectars, lowfat milk, skim milk, cheese, candy, and fruit drinks/ades. Decreases in intake were observed in whole milk and total milk, yeast breads/rolls, green beans, corn/green peas/lima beans, beef, and pork. Lower percentages of calories from fat were partly due to increased carbohydrate intakes. Adolescents had increases in thiamin, niacin, vitamin B₆, and iron and decreases in vitamin B₁₂. Servings per day from the food groups of the Food Guide Pyramid were used to discuss diet quality in the most recent survey. For any given Pyramid group, less than one-half of the adolescents consumed the recommended number of servings, and their intakes of discretionary fat and added sugars were much higher than recommended. Diets of adolescents still need to change in directions indicated by the Dietary Guidelines for Americans, including increases in intakes of whole grains, fruits, dark-green and deep-yellow vegetables, legumes, nonfat or lowfat dairy products, and lean meats. Additionally, increases in physical activity should be encouraged, as well as decreases in fats and added sugars. Effective nutrition education efforts for adolescents should be supported at every level.

As part of the National Nutrition Monitoring and Related Research Program, each of the U.S. Department of Agriculture (USDA) food and nutrient intake surveys provides a snapshot of the food choices made at a given time by the population of the United States. Information about trends in food and nutrient intakes by adults age 20 years and over and by children age 6 to 11 years has been published (Enns, Goldman, & Cook, 1997; Enns, Mickle, & Goldman, 2002). This article focuses on trends in intakes by adolescents age 12 to 19 years.

To examine whether adolescents' food intakes have changed over time, we compared nationally representative estimates from the most recent USDA survey of dietary intakes with similar estimates from two previous USDA surveys. The three surveys were the Continuing Survey of Food Intakes by Individuals (CSFII) 1994-96,¹ CSFII

¹Although the most recent USDA dietary intake survey encompassed the year 1998 as well as 1994-96, data collection in 1998 only included children under 10 years of age. For that reason, we identify the survey in this article as the CSFII 1994-96. The sampling weights constructed for analysis of the CSFII 1994-96 data were used for the present analysis.

1989-91, and the Nationwide Food Consumption Survey (NFCS) 1977-78 (Tippett et al., 1995; USDA, 1983, 1999, 2000a). The estimates reported in this study are of food intakes, the percentages of individuals consuming foods, and nutrient intakes for girls and boys age 12 to 19 years during all three periods. In the discussion of diet quality in the most recent survey, we cite information on intakes stated in terms of Food Guide Pyramid servings (USDA, 2000b).

Design and Methods

The Three Surveys

The CSFII 1994-96 was the most recent source of information on adolescents' intakes in the evolving series of USDA food and nutrient intake surveys that also includes the two earlier surveys (Tippett, Enns, & Moshfegh, 2000). Differences among the three surveys in sampling and methodology are discussed briefly in the following paragraphs. More information on methods in the NFCS 1977-78 and the CSFII 1989-91 is available elsewhere (Tippett et al., 1995; USDA, 1983).

The target population covered all 50 States in 1994-96 versus the 48 conterminous States in 1977-78 and 1989-91. In 1989-91 and 1994-96, the low-income population was over-sampled. In 1977-78 and 1989-91, all adolescents in sample households were eligible for inclusion in the survey; in 1994-96, selected individuals within each household were eligible. The number of adolescents age 12 to 19 years and the all-individuals Day-1 response rate, respectively, for each survey are 5,890 and 56.9 percent (NFCS 1977-78), 1,627 and 57.6 percent (CSFII 1989-91), and 1,469 and 80.0 percent (CSFII 1994-96).

In 1977-78 and 1989-91, dietary data were collected on 3 consecutive days

by using a 1-day dietary recall and a 2-day dietary record. In 1994-96, the number of days was reduced to two, partly to reduce respondent burden (Tippett & Cypel, 1998). Both days of CSFII 1994-96 dietary data were collected with 1-day dietary recalls; interviews were on nonconsecutive days, 3 to 10 days apart, to ensure that nutrient intakes on the 2 days would be statistically uncorrelated. Between the earlier surveys and the CSFII 1994-96, the 1-day recall was modified to include multiple passes through the list of all foods and beverages recalled by the respondent, with the goal of improving the completeness of the data collected (Tippett & Cypel, 1998).

The USDA Survey Nutrient Database was updated on an ongoing basis to incorporate additional nutrients and improved nutrient values as well as to reflect changes in foods on the market (Tippett & Cypel, 1998; Tippett et al., 1995; USDA, 1987, 1993).

Presentation of Estimates

Because the number of survey days and the method of data collection on Day 2 differed among the surveys, tables comparing food and nutrient intake estimates among the surveys are based on only Day-1 data collected from each individual. Using these data maximizes comparability among surveys. One-day data are appropriate for comparisons of group means. All estimates are weighted to be nationally representative.

Mean food intakes are presented "per individual," meaning intakes include those by both consumers and non-consumers of the food group. To calculate "per user" intakes of foods, researchers may divide the mean intake of a food group by the percentage of individuals using that food group, expressed as a decimal. Because only selected food subgroups are presented, subgroup intakes will not sum to the

food group total.² Food mixtures were not broken down; mixed foods reported by respondents were grouped by their main ingredient.³ One effect of this method of classifying food is the inflation of some food groups or subgroups (e.g., meat mixtures) and deflation of others (e.g., sugars and sweets) relative to the amounts they would contain if all ingredients were disaggregated.

Estimates based on a small number of observations or on highly variable data may tend to be less statistically reliable than estimates based on larger sample sizes or on less variable data. Standard errors may be used to calculate a measure of the relative variability of an estimate called the coefficient of variation, the ratio of the standard error to the estimate itself. Because the CSFII has a complex sample design, sampling weights and procedures for specialized standard error estimation were used in computing the estimates and standard errors (USDA, 2000a, documentation section 5). SAS version 8.2 (1999) and SUDAAN version 7.5.1 (Shah, Barnwell, & Bieler, 1997) were used for statistical calculations.

In the tables, we flagged estimates that are potentially less reliable because of factors such as small sample sizes or large coefficients of variation. The guidelines that were used for determining when a statistic may be less reliable involve the use of a variance inflation factor in the role of a broadly calculated design effect. Those guidelines have been described in detail elsewhere (USDA, 1999, appendix B). The

²Readers interested in subgroups not included here are directed to Tippett et al. (1995) and USDA (1983, 1999).

³See "Table Notes" in Tippett et al. (1995) and USDA (1983); see "Descriptions of Food Groups" in USDA (1999).

variance inflation factors used in this study were 1.19 (1977-78), 2.26 (1989-91), and 1.41 (1994-96).

Approximate *t* tests were performed to determine whether food and nutrient intakes and the percentages of individuals using foods were significantly higher or lower in 1977-78 versus 1989-91, 1989-91 versus 1994-96, and 1977-78 versus 1994-96. All told, some 460 pairs of estimates were compared. Because the analysis involved such a large number of comparisons, we used conservative criteria for significance. When significant differences are discussed in the text, they may be referred to either as “changes” (or values may be said to have risen/fallen or to be higher/lower in 1994-96 than in 1977-78) or as “trends.”

The term “change” is used only if intakes (or percentages using) in 1977-78 and 1994-96 were different when *p* was less than 0.001. The term “trend” is used only if two criteria were met: (1) mean intakes (or percentages using) either rose or fell progressively from one survey to the next (e.g., intake X rose between 1977-78 and 1989-91, then rose again between 1989-91 and 1994-96), and (2) *p* was less than 0.05 for both comparisons. For each trend, the level of significance noted in the tables (< 0.05 or < 0.01) is the one that is true of both the 1977-78 versus 1989-91 *t* test and the 1989-91 versus 1994-96 *t* test. For example, if the 1977-78 versus 1989-91 *t* test was significant at *p* < 0.01 but the 1989-91 versus 1994-96 *t* test was significant at *p* < 0.05, the latter level is shown in the table.

Results and Discussion

Beverages

Since the late 1970s, the overall picture of beverage intakes by adolescents has changed considerably. The diets of both girls and boys age 12 to 19 had decreasing trends over time in both intakes of total fluid milk and the percentages of individuals using fluid milk (tables 1-4). Both girls' and boys' diets had increasing trends in intakes of soft drinks, and boys' diets also had a trend to a higher percentage of individuals using soft drinks. In 1977-78 adolescents drank at least one and one-half times as much fluid milk as any other beverage, but by 1994-96 they drank about twice as much soft drinks as milk. Adolescents' intake of noncitrus juices and nectars—such as apple juice, grape juice, and 100-percent fruit juice blends—tripled between 1977-78 and 1994-96, although in the latter survey, they still drank less noncitrus juices than soft drinks, milk, or fruit drinks and ades. Adolescents' intakes of fruit drinks and ades, which contain little or no fruit juice, doubled between 1977-78 and 1994-96.

The shift in beverage intakes is of nutritional concern. Guenther (1986) found negative associations between intake of soft drinks and intakes of milk, calcium, magnesium, riboflavin, vitamin A, and vitamin C. Harnack, Stang, and Story (1999), in an analysis of CSFII 1994 data, reported a positive association between consumption of nondiet soft drinks and energy intake. Wyshak (2000) found that high-school-age girls who drink carbonated beverages may have a higher risk of bone fractures than is the case for girls who do not drink carbonated beverages. In a 19-month-long prospective study, Ludwig, Peterson, and Gortmaker (2001) observed an association between consumption of sugar-sweetened drinks

Although the percentages of adolescents drinking skim milk more than doubled between 1977-78 and 1994-96, they still remained low (7 to 9 percent)

and childhood obesity. Because the studies by Guenther (1986), Harnack et al. (1999), Wyshak (2000), and Ludwig et al. (2001) were observational, it cannot be inferred that the relationships between soft drinks and the negative outcomes described were causal. Further research is needed in this area.

Foods

Overall, the intakes of grain products were about two-fifths higher in 1994-96 than in 1977-78 for girls and boys age 12 to 19 years (tables 1 and 2). In all three surveys, the subgroup “mixtures mainly grain”—grain-based mixtures such as pasta with sauce, rice dishes, and pizza—accounted for the largest share (by weight) of grain products eaten by adolescents. Teenage girls’ and boys’ diets had increasing trends for both intakes and percentages using grain mixtures (tables 3 and 4).

Increasing trends were observed in adolescents’ intakes of grain-based snack foods from the group “crackers, popcorn, pretzels, and corn chips.” Among boys, there were also trends toward lower intakes and percentages consuming yeast breads and rolls; the decline in girls’ intakes and percentages using yeast breads and rolls could not be classified as a trend. Yeast breads and rolls are common components in sandwiches, and some sandwiches (especially fast-food items) are categorized under “mixtures mainly meat, poultry, fish.” Intake estimates for yeast breads and rolls would be higher if the breads and rolls from those sandwiches were included here.

In 1994-96 only 35 percent of girls and 48 percent of boys consumed the number of servings of grain products recommended in the Food Guide Pyramid based on their caloric intake (USDA, 2000b). Despite Pyramid recommendations to choose “several servings a day” of whole-grain foods

Table 1. Trends and changes in adolescent¹ girls’ mean intakes from selected food groups

Food group	Intake (grams)			Change ²	Trend ³
	1977-78	1989-91	1994-96		
Grain products	215	261	306	+91	**
Yeast breads and rolls	52	45	40	-12	
Ready-to-eat cereals	11	15	17	+6	
Cakes, cookies, pastries, pies	34	26	37		
Crackers, popcorn, pretzels, corn chips	5	8	15	+11	*
Mixtures mainly grain	59	100	132	+73	*
Vegetables	165	129	145		
White potatoes	61	56	61		
Fried white potatoes	18	31	31	+13	
Dark-green vegetables	6	5	9		
Deep-yellow vegetables	6	5 ⁴	4		
Tomatoes	16	17	18		
Green beans	8	5	4	-5	
Corn, green peas, lima beans	19	12	8	-11	
Fruits	129	133	157		
Citrus juices	53	68	67		
Apples	20	11	13		
Melons and berries	7	7	15		
Noncitrus juices and nectars	12	19	35	+23	
Milk and milk products	380	308	268	-112	
Fluid milk	303	239	189	-114	*
Whole milk	166	97	67	-99	*
Lowfat milk	53	115	91	+38	
Skim milk	13	16 ³	30	+17	
Milk desserts	25	20	29		
Cheese	9	15	14	+5	
Meat, poultry, and fish	186	152	158	-28	
Beef	46	19	21	-25	
Pork	16	11	5	-10	
Frankfurters, sausages, luncheon meats	17	15	15		
Chicken	21	20	19		
Fish and shellfish	10	6	6		
Mixtures mainly meat, poultry, fish	66	73	85		
Eggs	18	12	13		
Legumes	19	13	14		
Fats and oils	11	10	10		
Sugars and sweets	22	23	31		
Candy	5	6	12	+7	
Beverages	417	534	645	+228	**
Tea	89	87	92		
Fruit drinks and ades	72	87	134	+62	
Carbonated soft drinks	208	324	396	+188	*

¹12 to 19 years.

²Change = mean intakes in 1977-78 and 1994-96 are significantly different at $p < 0.001$.

³Trend = mean intake rose or fell progressively from 1977-78 through 1989-91 to 1994-96.

⁴Estimate is based on small sample size or coefficient of variation ≥ 30 percent.

* = trend significant at $p < 0.05$.

** = trend significant at $p < 0.01$.

Table 2. Trends and changes in adolescent¹ boys' mean intakes from selected food groups

Food group	Intake (grams)			Change ²	Trend ³
	1977-78	1989-91	1994-96		
Grain products	297	351	406	+109	*
Yeast breads and rolls	77	65	54	-23	*
Ready-to-eat cereals	18	25	29	+10	
Cakes, cookies, pastries, pies	48	45	49		
Crackers, popcorn, pretzels, corn chips	6	9	19	+14	*
Mixtures mainly grain	78	121	175	+96	**
Vegetables	209	173	176		
White potatoes	86	78	86		
Fried white potatoes	27	35	44	+17	
Dark-green vegetables	8	9	6		
Deep-yellow vegetables	8	4	6		
Tomatoes	17	22	28	+11	
Green beans	12	6 ⁴	3 ⁴	-9	
Corn, green peas, lima beans	27	20	10	-17	
Fruits	143	157	174		
Citrus juices	60	84	94		
Apples	24	20	13	-11	
Melons and berries	7	6 ⁴	11 ⁴		
Noncitrus juices and nectars	9	12	29	+20	
Milk and milk products	571	461	409	-162	
Fluid milk	472	376	303	-169	*
Whole milk	257	145	100	-157	*
Lowfat milk	88	197	157	+69	
Skim milk	17	22 ⁴	40		
Milk desserts	34	32	29		
Cheese	11	13	19	+8	
Meat, poultry, and fish	257	221	250		
Beef	64	34	30	-34	
Pork	24	12	12	-12	
Frankfurters, sausages, luncheon meats	26	27	28		
Chicken	26	26	26		
Fish and shellfish	9	7	8		
Mixtures mainly meat, poultry, fish	94	103	135	+41	
Eggs	28	16	22		
Legumes	28	27	17		
Fats and oils	13	14	12		
Sugars and sweets	32	29	35		
Candy	5	8	13	+8	*
Beverages	467	639	994	+527	**
Tea	98	95	115		
Fruit drinks and ades	98	104	205	+107	
Carbonated soft drinks	220	424	608	+388	**

¹12 to 19 years.

²Change = mean intakes in 1977-78 and 1994-96 are significantly different at $p < 0.001$.

³Trend = mean intake rose or fell progressively from 1977-78 through 1989-91 to 1994-96.

⁴Estimate is based on small sample size or coefficient of variation ≥ 30 percent.

* = trend significant at $p < 0.05$.

** = trend significant at $p < 0.01$.

(USDA, 1996), adolescents' intake of whole grains in 1994-96 was only about 1 serving per day.

Few trends were observed in adolescents' intakes of vegetables. It is important to remember that vegetables are frequently consumed as part of meat mixtures and grain mixtures. For adults in 1994, intakes of vegetables accounted for about 24 percent and 28 percent (by weight) of grain mixtures and meat mixtures, respectively (Enns et al., 1997). If vegetables account for a similar proportion of grain and meat mixtures for adolescents as for adults, then the observed higher intakes of grain mixtures would at least partially offset the lower intakes of vegetables. Further research is needed to clarify this issue. However, even when mixture ingredients are separated into their respective groups, 74 percent of adolescent girls and 67 percent of adolescent boys had diets that did not meet the Pyramid recommendations for servings of vegetables (USDA, 2000b). Despite Pyramid recommendations to eat both dark-green leafy vegetables and legumes "several times a week," adolescents ate no more than one-fifth of a serving from either category on any given day.

Adolescents' intakes of fried white potatoes were higher in 1994-96 than in 1977-78. The percentages of adolescents using tomatoes rose between 1977-78 and 1994-96, and the increase qualified as a trend among boys. Both girls and boys had lower intakes and lower percentages using the subgroups "green beans" and "corn, green peas, and lima beans" in 1994-96 than in 1977-78. The decrease in the percentage of boys using corn, green peas, and lima beans met the definition of a trend.

Aside from the observed changes in intakes of noncitrus juices and nectars,

few changes occurred in fruit consumption. Between 1977-78 and 1994-96, the percentage using citrus juices and apples fell among girls and both intakes and percentages using apples fell among boys. In 1994-96 only 18 percent of girls and 14 percent of boys consumed the number of servings of fruit recommended in the Food Guide Pyramid based on their caloric intake (USDA, 2000b).

Among milk and milk products subgroups, adolescents' intakes of some high-fat items (e.g., whole milk) decreased and others (e.g., cheese) increased. Notably, milk intakes shifted away from whole milk.⁴ Decreasing trends were seen both in adolescents' intakes of whole milk and in the percentages of adolescents using whole milk. Intakes of lower fat milks (2%, 1%, and skim) by adolescents surpassed those of whole milk in 1989-91. Although the percentages of adolescents drinking skim milk more than doubled between 1977-78 and 1994-96, they still remained low (7 to 9 percent), as did their intakes of skim milk (30 to 40 grams [g], or about 1 to 1-1/3 fluid ounces). None of the shifts in intakes of lower fat milks or percentages using them qualified as a trend.

On the other hand, increasing trends in the percentages of adolescents using cheese were seen. Although cheese intakes were higher in 1994-96 than in 1977-78, the increase did not qualify as a trend. Because cheese is a common

Table 3. Trends and changes in percentages of adolescent¹ girls using items from selected food groups

Food group	Percentage using			Change ²	Trend ³
	1977-78	1989-91	1994-96		
Grain products	96	97	98 ⁴		
Yeast breads and rolls	75	65	61	-15	
Ready-to-eat cereals	29	28	30		
Cakes, cookies, pastries, pies	40	30	41		
Crackers, popcorn, pretzels, corn chips	16	20	31	+15	
Mixtures mainly grain	23	39	46	+23	*
Vegetables	83	72	79		
White potatoes	51	45	46		
Fried white potatoes	28	32	35		
Dark-green vegetables	5	6	7		
Deep-yellow vegetables	7	7	11		
Tomatoes	22	29	35	+13	
Green beans	10	7	4	-6	
Corn, green peas, lima beans	18	12	7	-11	
Fruits	50	44	46		
Citrus juices	25	21	18	-7	
Apples	13	7	8	-5	
Melons and berries	3	3	6		
Noncitrus juices and nectars	4	7	10	+6	
Milk and milk products	84	77	75	-9	
Fluid milk	72	60	50	-22	**
Whole milk	42	29	18	-24	**
Lowfat milk	13	27	24	+11	
Skim milk	4	4	9	+6	
Milk desserts	18	14	17		
Cheese	19	29	36	+17	*
Meat, poultry, and fish	92	81	80	-12	
Beef	33	18	22	-11	
Pork	21	14	11	-10	
Frankfurters, sausages, luncheon meats	27	27	25		
Chicken	17	17	19		
Fish and shellfish	9	6	6		
Mixtures mainly meat, poultry, fish	32	35	34		
Eggs	23	13	15	-8	
Legumes	11	9	11		
Fats and oils	53	48	46		
Sugars and sweets	47	44	46		
Candy	9	12	24	+15	
Beverages	73	78	87	+14	
Tea	21	18	19		
Fruit drinks and ades	19	21	27		
Carbonated soft drinks	46	58	62	+17	

⁴Another shift occurred that can be seen by summing the milk subgroup intakes (whole, lowfat, and skim) in a given survey and dividing by the intake of total fluid milk. A greater proportion of total fluid milk was allocated to a specific fat level in later years than in 1977-78. The increase may indicate a greater awareness of the fat level of milk, because the ability to classify fluid milk as whole, lowfat, or skim depends on information provided by respondents. Milk whose fat level was not specified was included under total fluid milk but not in any of the subgroups.

¹12 to 19 years.

²Change = percentages in 1977-78 and 1994-96 are significantly different at $p < 0.001$.

³Trend = percentage rose or fell progressively from 1977-78 through 1989-91 to 1994-96.

⁴Estimate is based on small sample size or coefficient of variation ≥ 30 percent.

* = trend significant at $p < 0.05$.

** = trend significant at $p < 0.01$.

Table 4. Trends and changes in percentages of adolescent¹ boys using items from selected food groups

Food group	Percentage using			Change ²	Trend ³
	1977-78	1989-91	1994-96		
Grain products	98	97	98 ⁴		
Yeast breads and rolls	81	71	63	-19	*
Ready-to-eat cereals	37	35	33		
Cakes, cookies, pastries, pies	45	39	41		
Crackers, popcorn, pretzels, corn chips	15	20	27	+12	
Mixtures mainly grain	25	37	46	+21	*
Vegetables	87	81	78	-9	
White potatoes	58	50	50	-9	
Fried white potatoes	34	37	39		
Dark-green vegetables	6	6	4		
Deep-yellow vegetables	8	8	8		
Tomatoes	23	32	43	+20	**
Green beans	12	6	3	-9	
Corn, green peas, lima beans	23	14	7	-15	**
Fruits	50	44	45		
Citrus juices	26	24	22		
Apples	13	10	8	-5	
Melons and berries	3	3	4		
Noncitrus juices and nectars	3	4	8	+5	
Milk and milk products	90	87	81	-9	
Fluid milk	82	72	60	-22	**
Whole milk	50	31	23	-27	**
Lowfat milk	16	39	31	+15	
Skim milk	3	5	7	+4	
Milk desserts	20	16	14	-7	
Cheese	19	27	37	+18	**
Meat, poultry, and fish	96	90	87	-9	
Beef	37	26	24	-13	
Pork	27	14	16	-11	
Frankfurters, sausages, luncheon meats	32	35	32		
Chicken	16	18	18		
Fish and shellfish	7	5	5		
Mixtures mainly meat, poultry, fish	37	36	38		
Eggs	28	15	17	-11	
Legumes	12	11	11		
Fats and oils	54	52	43	+11	
Sugars and sweets	53	41	47		
Candy	8	14	21	+13	**
Beverages	72	78	87	+16	
Tea	21	14	16		
Fruit drinks and ades	20	18	28	+8	
Carbonated soft drinks	43	59	69	+26	*

¹12 to 19 years.

²Change = percentages in 1977-78 and 1994-96 are significantly different at $p < 0.001$.

³Trend = percentage rose or fell progressively from 1977-78 through 1989-91 to 1994-96.

⁴Estimate is based on small sample size or coefficient of variation ≥ 30 percent.

* = trend significant at $p < 0.05$.

** = trend significant at $p < 0.01$.

component in both grain and meat mixtures, estimates for cheese would be even higher if the cheese that was an ingredient in these mixtures were included here. In 1994-96 only 12 percent of girls and 30 percent of boys consumed the number of servings of dairy products recommended in the Food Guide Pyramid based on their age (USDA, 2000b).

The percentages of both girls and boys using foods from the meat, poultry, and fish group were lower in 1994-96 than in 1977-78. Both intakes and percentages of individuals using beef and pork separately (i.e., not as part of a mixture) fell. In all three surveys, intakes of “mixtures mainly meat, poultry, fish”—such as beef stew, hamburgers, chicken pot pie, and tuna salad—accounted for the largest share of intakes of total meat, poultry, and fish. Percentages of adolescents consuming eggs were lower in 1994-96 than in 1977-78.

In 1994-96 only 22 percent of girls and 44 percent of boys consumed the number of servings of meat and meat alternates recommended in the Food Guide Pyramid based on their caloric needs (USDA, 2000b). Cooked dry beans (other than soybeans) and peas, which may be tabulated under either the vegetable group or the meat group, were tabulated under the meat group for that analysis; otherwise, the percentages consuming the recommended number of servings from the meat group would have been even lower.

For both girls and boys, intakes and percentages using candy increased between 1977-78 and 1994-96.

However, the increases qualified as trends only for the adolescent boys. Fats, oils, and sugars are common ingredients in foods; thus, the estimates of intakes and percentages using fats, oils, and sugars would be higher if the amounts that were ingredients in other foods were included here.

In 1994-96, intakes of discretionary fat and added sugars⁵—items from the tip of the Pyramid—were much higher than recommended (USDA, 2000b). Among adolescents, discretionary fat intake accounted for about 25 percent of calories for girls and 26 percent for boys. In a diet that meets all other Pyramid recommendations, discretionary fat intake would be expected to be closer to 15 percent of calories (USDA, 1996). In 1994-96, adolescent girls consumed 23 teaspoons of added sugars per day in a diet providing around 1,800 calories; adolescent boys consumed 34 teaspoons of added sugars per day in a diet providing around 2,700 calories. The Pyramid suggests that Americans try to limit their added sugars to 6 teaspoons a day if they eat about 1,600 calories, 12 teaspoons at 2,200 calories, or 18 teaspoons at 2,800 calories (USDA, 1996).

Energy Out of Balance

Over roughly the same period covered by the present analysis, the percentages of 12- to 19-year-old boys in the United States who were overweight⁶ rose from 4.5 percent in 1976-80 to 11.3 percent in 1988-94; among adolescent girls, the increase was from 5.4 to 9.7 percent (U.S. Department of Health and Human Services [DHHS], 2001). The increasing prevalence of overweight is of concern for many reasons, including the increasing incidence and prevalence of Type II diabetes mellitus among overweight and obese adolescents (American Diabetes Association, 2000). Overweight in adolescence is also associated with high blood lipids,

Table 5. Trends and changes in adolescent¹ girls' and boys' mean intakes of food energy and selected nutrients and mean percentages of calories from protein, fat, and carbohydrate

Food group	Intake			Change ²	Trend ³
	1977-78	1989-91	1994-96		
	n=2,993	Girls n=837	n=732		
Energy (kcal)	1,797	1,748	1,910		
Protein (g)	70.6	66.0	65.3	-5.3	
Fat (g)	80.0	67.4	69.3	-10.7	
Carbohydrate (g)	202.0	223.5	261.9	+59.9	**
Protein (% kcal)	16.0	15.4	14.0	-2.0	
Fat (% kcal)	39.3	33.8	32.2	-7.2	*
Carbohydrate (% kcal)	45.4	51.7	55.0	+9.6	**
Vitamin A (IU)	4,410	4,554	4,817		
Vitamin C (mg)	78	90	95		
Thiamin (mg)	1.23	1.39	1.44	+0.21	
Riboflavin (mg)	1.72	1.72	1.75		
Niacin (mg)	16.7	18.1	19.0	+2.3	
Vitamin B ₆ (mg)	1.37	1.42	1.53	+0.16	
Vitamin B ₁₂ (μg)	5.34	3.66	3.80	-1.54	
Calcium (mg)	784	797	771		
Phosphorus (mg)	1,127	1,123	1,108		
Magnesium (mg)	213	216	223		
Iron (mg)	10.3	11.9	13.8	+3.5	**
	n=2,897	Boys n=790	n=737		
Energy (kcal)	2,523	2,459	2,766	+243	
Protein (g)	99.8	93.1	97.5		
Fat (g)	113.7	96.8	102.8	-10.8	
Carbohydrate (g)	279.0	310.9	366.1	+87.0	**
Protein (% kcal)	16.1	15.6	14.4	-1.7	
Fat (% kcal)	39.9	34.7	33.1	-6.8	**
Carbohydrate (% kcal)	44.6	50.8	53.2	+8.5	**
Vitamin A (IU)	6,018	5,893	6,361		
Vitamin C (mg)	97	114	119		
Thiamin (mg)	1.76	1.99	2.13	+0.36	
Riboflavin (mg)	2.51	2.49	2.58		
Niacin (mg)	23.3	25.0	27.8	+4.4	*
Vitamin B ₆ (mg)	1.92	2.01	2.21	+0.29	
Vitamin B ₁₂ (μg)	7.50	5.89	5.85	-1.65	
Calcium (mg)	1,145	1,145	1,145		
Phosphorus (mg)	1,608	1,598	1,633		
Magnesium (mg)	301	299	311		
Iron (mg)	14.5	17.8	19.8	+5.3	*

¹12 to 19 years.

²Change = mean intakes (or percentages) in 1977-78 and 1994-96 are significantly different at p < 0.001.

³Trend = mean intake (or percentage) rose or fell progressively from 1977-78 through 1989-91 to 1994-96.

* = trend significant at p < 0.05.

** = trend significant at p < 0.01.

⁵For definitions of discretionary fat and added sugars, see appendix D in Pyramid Servings table set 1 (USDA, 2000b).

⁶Overweight is defined as body mass index (BMI) at or above the sex- and age-specific 95th percentile BMI cutoff points reported in the revised *CDC Growth Charts: United States* (Kuczmarski et al., 2000).

hypertension, an increased likelihood of overweight in adulthood, and various other problems (DHHS, 2001).

In the face of increasing overweight, one would expect to see either increasing energy intake or decreasing energy expenditure or both. In the present analysis, no significant trends or changes were seen in energy intakes between 1977-78 and 1994-96 (table 5). Adolescent boys' energy intake was over 200 kcal higher in 1994-96 than in 1977-78 (2,766 kcal vs. 2,523 kcal). Girls' energy intake was 1,910 kcal in 1994-96 and 1,797 kcal in 1977-78, but no significant difference was found.

Findings of underreporting in surveys, which are often but not always higher among overweight respondents, might lead one to speculate that the lack of a trend in energy intake could be due to increased underreporting over time as a function of increased obesity. On the other hand, methodological improvements in the Agricultural Research Service's 24-hour recall have addressed several issues that are considered important in obtaining complete intake data (see "Design and Methods").

Using CSFII data, Krebs-Smith et al. (2000) identified low-energy reporters by first estimating basal metabolic rate (BMR)⁷ based on self-reported body weight, gender, and age and then comparing the BMR estimates with a cutoff level.⁸ They found that the percentage of adults who were low-energy reporters was lower in 1994-96 (15 percent) than in 1989-91 (25 percent).

⁷BMR was estimated by using the formula developed by Schofield (1985).

⁸Eighty percent of BMR was the cutoff level used. That level was proposed by Goldberg et al. (1991) as the lower limit of plausible energy intake for a single individual with 2 days of intake data and 99.7 percent confidence limits.

They also found less underreporting among adolescents than among adults. Only 9.5 percent of adolescents age 12 to 19 in 1994-96 were found to be low-energy reporters (S.M. Krebs-Smith, personal communication, March 8, 2002). Livingstone and Robson (2000) have stated that determining whether an adolescent's energy intake is implausibly low should take into account detailed information on the adolescent's activity level; however, such information is not available from the three surveys in the present analysis.

Inactivity is probably a strong factor in the increased prevalence of overweight in the United States (DHHS, 2001; Weinsier, Hunter, Heini, Goran, & Sell, 1998). In 1996 the Surgeon General concluded that nearly half of American youths 12 through 21 years of age are not vigorously active on a regular basis, that about one-tenth of them are not active at all, and that physical activity declines during adolescence (DHHS, 1996).

The Dietary Guidelines for Americans recommend that adolescents engage in at least 60 minutes of moderate physical activity on most days of the week, preferably daily (USDA & DHHS, 2000). One strategy suggested by the Dietary Guidelines to help teens increase their activity is to limit television watching. On any given day in 1994-96, 32 percent of girls and 34 percent of boys age 12 to 19 watched 4 or more hours of television or videos, 29 percent of girls and 34 percent of boys watched 2 to 3 hours, and 39 percent of girls and 33 percent of boys watched 1 hour or less (unpublished data).

Energy-Providing Nutrients (Macronutrients)

Trends toward higher carbohydrate intakes were evident among both adolescent girls and boys. For girls, carbohydrate intake was about 60 g per

For girls, carbohydrate intake was about 60 g per day higher in 1994-96 than in 1977-78; for boys, the intake was 87 g higher.

day higher in 1994-96 than in 1977-78; for boys, the intake was 87 g higher. For both girls and boys, protein and fat intakes were lower in 1994-96 than in 1977-78, although the p value criterion for a trend was not met.

These shifts in adolescents' macro-nutrient intakes between 1977-78 and 1994-96 were reflected in trends toward a lower proportion of food-energy intake from fat and a higher proportion from carbohydrate. Adolescents' percentage of calories from protein was also lower in 1994-96 than in 1977-78, but the trend definition was not met. The proportion of energy from fat in adolescents' diets in 1994-96 (33 percent for girls and 32 percent for boys) was still higher than what is recommended by the Dietary Guidelines for Americans: 30 percent of calories or less (USDA & DHHS, 2000). At 11 percent of calories for girls and 12 percent of calories for boys (unpublished data), saturated fat intakes still exceeded the recommendation of less than 10 percent of calories.

Although the shifts in the proportion of energy intake from fat and carbohydrate appear to have brought the macro-nutrient proportions in the average diet nearer to the recommended levels, a closer examination is less encouraging. The observed decrease in the percentage of calories from fat is more due to the increase in calories from carbohydrate than to the decrease in fat intake. Fat intake decreased by almost 100 kcal for both girls and boys, but carbohydrate intake increased by about 240 kcal for girls and almost 350 kcal for boys, based on estimates in table 5 that were multiplied by Merrill and Watt's (1973) general conversion factors of 9 kcal/g for fat and 4 kcal/g for carbohydrate.

Vitamins, Minerals, and Other Dietary Components

Increasing trends were observed in iron intakes for both adolescent girls and boys (table 5). Boys' diets had an increasing trend in niacin intake, and girls' diets had a higher intake that did not meet the trend criteria. Additionally, thiamin and vitamin B₆ intakes for adolescents were higher, and vitamin B₁₂ intakes were lower.

Mean dietary fiber intakes in 1994-96 were 13 g for girls and 17 g for boys (unpublished data). The Institute of Medicine (2002) has set the adequate intake of total fiber (which equals dietary fiber plus a minor amount of functional fibers) at 26 g/day for girls 9 to 18 years, 31 g/day for boys 9 to 13 years, and 38 g/day for boys 14 to 18 years. Observed increases in carbohydrate intakes were paralleled neither by significant increases in dietary fiber intakes nor by increases in overall intakes of fiber-rich foods.

Summary and Recommendations

The pattern of results seen for adolescents echoes many of the findings for adults and children (Enns, Goldman, & Cook, 1997; Enns, Mickle, & Goldman, 2002). Adolescents' food intakes changed in various ways during the last quarter of the 20th century. Adolescents' diets exhibited trends not only toward large increases in intakes of soft drinks but also toward decreases in intakes of total fluid milk that were driven by decreases in whole milk. Some other shifts were to higher intakes of grain products (especially grain mixtures), crackers/popcorn/pretzels/corn chips, fried potatoes, noncitrus juices/nectars, lowfat milk, skim milk, cheese, candy, and fruit drinks/ades. Other shifts were to lower intakes of yeast breads/rolls,

green beans, corn/green peas/lima beans, beef, and pork.

Despite those shifts in intakes, most of the take-home messages about how to improve adolescents' diets remain the same:

- Eat more whole grains.
- Eat more vegetables, especially dark-green and deep-yellow vegetables.
- Eat more fruits—both citrus and noncitrus, with an emphasis on whole fruits rather than juices.
- Eat more legumes.
- Shift to lean meats and meat alternates.
- Drink more skim or 1% milk, or eat more lowfat dairy products, or include plenty of nondairy sources of calcium.
- Decrease the amount of fat used in cooking.

The amount of discretionary fat and added sugars in adolescents' diets is much higher than is recommended by the Food Guide Pyramid. Adolescents' diets would benefit overall from lowering intakes of "empty-calorie" foods and beverages that are high in fats and sugars but provide few other nutrients. In addition, when choosing among more nutrient-dense foods, adolescents would do well to shift toward items lower in fat and sugar.

Increases in intakes of foods high in fiber and complex carbohydrate—such as whole grains, vegetables, fruits other than fruit juices, and legumes—could lead to a diet lower in fat and added sugars and higher in fiber and complex carbohydrate. If such a change led to a lower overall energy intake, weight maintenance or loss would be made easier. Because widespread inactivity has been identified as a factor in the national epidemic of overweight, increased activity should be

encouraged. In a recent *Call to Action*, the Surgeon General outlined key actions to address overweight and obesity (DHHS, 2001).

Educational efforts and interventions successfully change dietary behavior among adolescents, and factors leading to the effectiveness of nutrition education have been identified ("Adolescent Nutrition," 2002; Contento et al., 1995). Resources must be committed on every level—national, State, local, community, school, and family, as well as in the health care system—to help adolescents eat more healthfully and become more active.

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